CLAIMS

1. Water-soluble film comprising a polyurethane polymer(s), which polyurethane polymer(s) has:
10 to 35 weight %, based on the weight of polyurethane polymer, of poly(ethylene oxide) groups which have a chain length(s) corresponding to a number average molecular weight within the range of from ~~200 to 5,000~~ Daltons;
15 to 150 millequivalents, per 100g of polyurethane polymer, of acid-functional groups; and wherein
at least 50% of the acid-functional groups are neutralised, such neutralisation being with a base(s) at least part of which is a non-volatile base(s);
and said polyurethane polymer(s) is a chain extended product formed using:

(A) a prepolymer component comprising an isocyanate-terminated polyurethane prepolymer, said component being formed from reactants which comprise:
  (i) at least one organic polyisocyanate,
  (ii) ~~if poly(ethylene oxide) groups are present,~~ at least one isocyanate-reactive compound providing said poly(ethylene oxide) groups in the resulting polyurethane polymer, and
  (iii) at least one isocyanate-reactive compound providing said acid-functional groups in the resulting polyurethane polymer, and

(B) an active hydrogen component comprising an active hydrogen chain-extending compound(s).

2. Film according to claim 2 wherein the amount of said poly(ethylene oxide) groups is within the range of 2 to ~~35~~ 30 weight % based on the weight of the polyurethane polymer, more preferably ~~2 to 20 weight % and especially~~ 2 to 15 wt %.

3. Film according to either claim 1 or claim 2 wherein the amount of said poly(ethylene oxide) groups is within the range of 5 to 35 weight % based on the weight of the polyurethane polymer, more preferably 5 to 20 weight %, and especially 5 to 15 weight %.

4. Film according to ~~any one of the preceding claims~~ claim 1 wherein said poly(ethylene oxide) groups ~~if present~~ have a chain length corresponding to a number average molecular weight within the range of ~~from 300 to 3000 Daltons, preferably~~ of from 500 to 2000 Daltons.

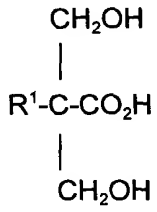
5. Film according to ~~any one of the preceding claims~~ claim 1 wherein said poly(ethylene oxide) groups ~~if present~~ are at least in-chain in the polyurethane polymer.

6. Film according to claim 5 wherein the isocyanate-reactive compound providing in-chain poly(ethylene oxide) groups ~~if present~~ is a poly(ethylene glycol).

7. Film according to ~~any one of the preceding claims~~ wherein the amount of acid functional groups present in the polyurethane polymer provides 30 to 125 millequivalents of such groups per 100g of polyurethane polymer, ~~preferably 45 to 115 milliequivalents~~.

8. Film according to ~~any one of the preceding claims~~ wherein said acid functional groups are carboxylic acid or sulphonic acid groups.

9. Film according to claim 8 wherein the isocyanate-reactive compound providing acid functional groups is a dihydroxyalkanoic acid of formula



where R^1 is hydrogen or alkyl, preferably of 1 to 5 carbon atoms.

10. Film according to claim 9 where said compound is 2,2-dimethylol propionic acid (DMPA).

11. Film according to claim 8 wherein the isocyanate-reactive compound providing acid functional groups is a diol bearing a sulphonic acid alkali metal salt, preferably a sulphonic acid sodium salt.

12 Film according to ~~any one of the preceding claims~~ wherein the reactants for forming the prepolymer component (A) include an isocyanate-reactive compound(s) which is monofunctional with regard to isocyanate-reactive functionality and acts as a chain-terminating material for the prepolymer.

13 Film according to ~~any one of the preceding claims~~ wherein said polyurethane polymer optionally incorporates poly(propylene oxide) groups, preferably being at least in-chain groups and preferably being present in an amount of 0 to 60 weight % based on the weight of the polyurethane polymer, more preferably 0 to 45 weight %.

14 Film according to ~~any one of the preceding claims~~ wherein said active hydrogen component (B) comprises an active hydrogen chain-extending compound(s) provided by

the reaction of water with said prepolymer, preferably being the sole chain-extending material of component (B).

15. Film according to ~~any one of the preceding claims~~ claim 1 wherein said active hydrogen component (B) comprises an added active hydrogen chain-extending compound.

16. Film according to claim 15, wherein said added active-hydrogen chain extending compound is a primary or secondary aliphatic, alicyclic, aromatic, araliphatic or heterocyclic polyamine, preferably a diamine, or hydrazine (including its monohydrate) or a substituted hydrazine.

17. Film according to claim 16 wherein said added active hydrogen chain-extending compound is hydrazine or hydrazine monohydrate.

18. Film according to ~~any one of the preceding claims~~ claim 1 wherein at least 90% of the acid functional groups in the polyurethane polymer are neutralised, more preferably 100%.

19. Film according to ~~any one of the preceding claims~~ claim 1 wherein at least 50 weight %, more preferably 100 weight %, of the base(s) used for neutralisation is selected from Group IA monovalent metal bases or basic salts, triethanolamine, 2-methyl-2-amino-1-propanol, and quaternary ammonium hydroxides.

20. Film according to claim 19 wherein said base is selected from NaOH, KOH and LiOH, and is preferably NaOH.

21. Film according to either claim 19 or claim 20 wherein the amount of base used provides an excess of base required for the neutralisation of all the acid groups, the amount of excess base remaining after neutralisation being up to 10 weight % based on the weight of the film.

22. Film according to ~~any one of the preceding claims~~ claim 1 wherein the polymeric material thereof also includes a polymer(s) which is other than a polyurethane and does not detract from the water-solubility of the film.

23. Film according to claim 22 wherein said other polymer(s) is selected from polyvinyl alcohol and neutralised carboxylic acid - or sulphonic acid-functional vinyl (preferably acrylic) polymer.

24. Film according to ~~any one of the preceding claims~~ claim 1 wherein said film is soluble in water at temperatures $\leq$ 35°C as well as at temperatures >35°C.

25. Aqueous solution of a polyurethane polymer, which polymer is as defined in ~~any one of one of claims 1 to 21~~.

26. Water-soluble packaging, preferably in the form of a sachet, capsule or bag, in which the enveloping film of the sachet comprises a film as defined according to ~~any one of claims 1 to 24~~.

27. Water-soluble packaging according to claim 26 wherein the film thereof is of the monolayer type or the laminate type.

28. Use of water-soluble packaging according to either claim 26 or claim 27 for packaging a material.

29. Combination of water-soluble packaging according to either claim 26 or claim 27 and a material packaged therein.

30. Process for the production of an aqueous polyurethane polymer solution, which polyurethane polymer has:
0 to 35 weight %, based on the weight of polyurethane polymer, of poly(ethylene oxide) groups which have a chain length(s) corresponding to a number average molecular weight within the range of 200 to 5,000 Daltons;
15 to 150 milliequivalents, per 100 g of polyurethane polymer, of acid-functional groups; and wherein
at least 50% of the acid-functional groups are neutralised, such neutralisation being with a base(s) at least part of which is a non-volatile base(s);
said process comprising

I. synthesising a prepolymer component comprising an isocyanate-terminated polyurethane prepolymer from reactants which comprise:
   (i) at least one organic polyisocyanate
   (ii) if poly(ethylene oxide) groups are present, at least one isocyanate-reactive compound providing said poly(ethylene oxide) groups in the resulting polyurethane polymer, and
   (iii) at least one isocyanate-reactive compound providing said acid-functional groups in the resulting polyurethane polymer;

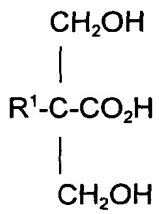
II. chain extending said prepolymer component using an active hydrogen component comprising an active hydrogen chain extending compound(s) to form said polyurethane polymer; and

III. forming an aqueous solution of said polyurethane polymer.

31. Process according to claim 30 wherein said chain extension step II is carried out simultaneously with the step of forming an aqueous solution of said polyurethane polymer in step III by dispersion of the polyurethane prepolymer into an aqueous medium containing an active hydrogen component and/or in which an active hydrogen component is formed, or into an aqueous medium into which an active hydrogen component is subsequently added.

32. Process according to either claim 30 or 31 wherein the isocyanate-reactive compound providing poly(ethylene oxide) groups if present in step I is a poly(ethylene glycol).

33. Process according to any one of claims 30 to 32 wherein the isocyanate-reactive compound providing acid functional groups in step I is a dihydroxyalkanoic acid of formula



where R^1 is hydrogen or alkyl, preferably of 1 to 5 carbon atoms.

34. Process according to claim 33 where said compound is 2,2-dimethylol proprionic acid (DMPA).

35. Process according to ~~any one of claims 30 to 32~~ claim 30 wherein the isocyanate-reactive compound providing acid functional groups in step 1 is a diol bearing a sulphonic acid alkali metal salt, preferably a sulphonic acid sodium salt.

36. Process according to ~~any one of claims 30 to 35~~ claim 35 wherein the reactants for forming the prepolymer component in step I include an isocyanate-reactive compound(s) which is monofunctional with regard to isocyanate-reactive functionality and acts as a chain-terminating material for the prepolymer.

37. Process according to ~~any one of claims 30 to 36~~ claim 36 wherein said active hydrogen component used in step II comprises an active hydrogen chain extending compound(s) provided by the reaction of water with said prepolymer, preferably being the sole chain extending material used in step II.

38. Process according to ~~any one claims 30 to 37~~ claim 37 wherein said active hydrogen component used in step II comprises an added active hydrogen chain extending compound.

39. Process according to claim 38, wherein said added active hydrogen chain extending compound is a primary or secondary aliphatic, alicyclic, , aromatic, araliphatic or heterocyclic polyamine, preferably a diamine, or hydrazine (including its monohydrate) or a substituted hydrazine.

40. Process according to claim 39 wherein said added active hydrogen chain extending compound is hydrazine or hydrazine monohydrate.

41. Process according to ~~any one of claims 30 to 40~~ claim 40 wherein at least 90% of the acid functional groups in the polyurethane polymer are neutralised, more preferably 100%.

42. Process according to ~~any one of claims 30 to 41~~ claim 41 wherein at least 50 weight %, more preferably 100 weight % of the base(s) used for neutralisation is selected from Group IA monovalent metal bases or basic salts, triethanolamine, 2-methyl-2-amino—1-propanol, and quaternary ammonium hydroxides.

43. Process according to claim 42 wherein said base is selected from NaOH, KOH, and LiOH, and is preferably NaOH.

44. Process according to either claim 42 or claim 43 wherein the amount of base used provides an excess of base required for neutralisation of all the acid groups, the amount of excess base remaining after neutralisation being up to 10 weight % based on the weight of film formed from the aqueous polyurethane solution.

45. Polyurethane polymer which has:
0 to 35 weight %, based on the weight of polyurethane polymer, of poly(ethylene oxide) groups which have a chain length(s) corresponding to a number average molecular weight within the range of from 200 to 5000 Daltons;
15 to 150 milliequivalents, per 100g of polyurethane polymer, of acid-functional groups; and wherein
at least 50% of the acid-functional groups are neutralised, such neutralisation being with a base(s) at least part of which is a non-volatile base(s);
and said polyurethane polymer being a chain extended product formed using:

(A) a prepolymer component comprising an isocyanate-terminated polyurethane prepolymer, said component being formed from reactants which comprise :

(i) at least one organic polyisocyanate;

(ii) if poly(ethylene oxide) groups are present, at least one isocyanate-reactive compound providing said poly(ethylene oxide) groups in the resulting polyurethane polymer; and

(iii) at least one isocyanate-reactive compound providing said acid-functional groups in the resulting polyurethane polymer,

and

(B) an active hydrogen component comprising an active hydrogen chain-extending compound(s)

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